CONFIGURABLE SWITCH ARRAY

BACKGROUND OF THE INVENTION

[0001] 1. Technical Field:

[0002] The present invention relates to switch arrays for motor vehicle instrument panels and more particularly to a switch array allowing free substitution and replacement of switches without rewiring of the panel.

[0003] 2. Description of the Problem:

[0004] A large number of two and three position electrical switches are mounted on the instrument panel of contemporary motor vehicles, particularly heavy duty vehicles such as trucks. Typically these switches are mounted in arrays which accommodate as many as six switches. The particular functions controlled by these switches are dependent upon the options and accessories installed on a truck, which may be subject to change depending upon different uses to which the truck is put, or even depending upon the type of trailer pulled by the truck. In the past, once a switch was installed on a dash or instrument panel, it has been difficult to mount new switches, remove switches, or to change the position of switches to suit the preferences of the driver/operator due to the need to rewire the instrument panel.

[0005] United States Patent 6,140,593 to Bramesfeld et al., teaches a switch array which allows two-position switches to be added to, removed from, or moved in a switch pack array. The switch array taught by Bramesfeld provided a housing having a number of bores extending from a front face of the housing through to the rear face. A resilient switch card is positioned on the rear face of the housing having contact areas aligned on the plurality of bores through the housing. Switch caps are moveably (and removably) positioned in the bores for sliding movement in the bores. One or more pins projects from each switch cap and is brought into contact with contact areas on the switch card upon depression of the switch cap. Because the arrangement of the pins is unique to particular loads, the combination of contact areas

impinged upon depression of the switch cap generates a unique signal indicating the load to be activated.

[0006] Since depression of the switch cap is required before identification of the switch type is made, the switch array of Bramesfeld does not conveniently provide for three position switches. Nor does Bramesfeld allow identification of switches to be made when the switch is not closed.

SUMMARY OF THE INVENTION

[0007] According to the invention there is provided a configurable switch array for use in motor vehicle instrument panels. Switches are freely positionable in, movable on and removable from the instrument panel with identification of the intended functionality of the switch assembly being determined upon the positioning of the switch assembly in the switch array. Each switch assembly includes a housing. Associated with each housing are identifying indicia having a pattern uniquely associated with a particular vehicle function. A circuit board underlying the switch array housing includes indicia identifying features allowing an identifying number to be generated for the switch assembly. Typically the identifying indicia are a plurality of identification fingers projecting from the bottom of a switch assembly housing. The pattern and number of the identification fingers indicate the function the switch assembly is to invoke and impinge against identification contact areas on the circuit board upon installation of a switch assembly.

[0008] Additional effects, features and advantages will be apparent in the written description that follows.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] The novel features believed characteristic of the invention are set forth in the appended claims. The invention itself however, as well as a preferred mode of use, further objects and advantages thereof, will best be understood by reference to the following detailed description of an illustrative embodiment when read in conjunction with the accompanying drawings, wherein:

[0010] **Fig. 1** is a cut away perspective view of truck illustrating the location of a vehicle electronic control system;

[0011] **Fig. 2** is a high level block diagram of the vehicle electronic control system;

[0012] **Fig. 3** is a detailed block diagram of switch array control arrangements from the vehicle electronic control system of **Fig. 2**;

[0013] **Fig. 4** is a perspective view of a switch array;

[0014] **Fig. 5** is an exploded perspective view of the switch array of **Fig. 4**;

[0015] **Fig. 6** is a perspective view of circuit board for the switch array; and

[0016] **Fig. 7** is a perspective view of rocker housing for a switch from the switch array.

[0017] **Fig. 8** is a cross sectional view of a portion of a switch and circuit board.

DETAILED DESCRIPTION OF THE INVENTION

[0018] Referring now to the figures and in particular to **Fig. 1** there is illustrated a vehicle electrical system **10** installed on a vehicle **13**. Vehicle electrical system **10** comprises a body controller **30** which manages a number of vocational controllers distributed about vehicle **13** by communication over data transmission links. Most vehicle electrical components are directly controlled by one of a group of vocational controllers or by the body controller **30**. Included among the vocational controllers are a gauge cluster controller **14**, an engine controller **20**, and transmission controller **16**, an anti-lock brake system controller **22** and the special case of the body controller **30**. An instrument and switch bank **12** is under the control of the gauge cluster controller **14**. These vocational controllers are generally supplied by suppliers of the related components. For example, the engine controller **20** is supplied with an engine by an engine

manufacturer. Control signal protocols for these controllers are both standardized and public as part of the SAE J1939 standard. The vocational controllers are linked to one another using a J1939 data link **18**. A diagnostic port **36** is provided for connection of an external diagnostic computer, which may be attached to the data link **18** as a temporary network node.

[0019] A second serial data bus **42**, also constructed in accordance with the SAE J1939 standard, provides for proprietary data transmission among control modules **40** installed on vehicle **13** by the vehicle's manufacturer. Control modules **40** may be provided to control any manner of specialized devices on a vehicle such as motors for water pumps on a fire fighting truck or blowers for HVAC units on busses.

[0020] Referring now to **Figs. 2** and **3**, a more detailed illustration of vehicle control system **10** and the configurable switch array control circuitry is provided. In addition to the large bandwidth data links **18** and **42**, control system **10** includes a smaller bandwidth data link **52** constructed in accordance with the SAE J1708 standard over which body controller **30** communicates with one or more switch arrays **51**. Body controller **30** also provides signals to a plurality of discrete outputs **53** (including typically vehicle lamps among other devices) and receives signals from a plurality of discrete input sources **55**. As described above, data link **18** couples a plurality of vocational controllers, including a gauge controller **14**, an engine controller **20**, a transmission controller **16**, an ABS controller **22** and body controller **30**, and provides a connection point for a temporary diagnostic controller mode, e.g. diagnostic connector **36**. Customer data link **42** couples a second group of controllers **40A-C**, which are directed to vehicle specific functions, and body controller **30** which is the direct source of instructions to these controllers. Switches installed in switch arrays **51** may advantageously be used to direct body controller **30** to provide control signals to both discrete outputs **53** and to control modules **40A-C**. Switch arrays **51** may also be used to initiate control signals for transmission on data link **18**.

[0021] Switches in a switch array **51** are not directly connected to body controller **30**, but rather communicate with the body controller through a local switch array controller or microprocessor **32** which handles communications with the body controller over a J1708 bus **52**. Microprocessor **32** selects a particular switch location by switch location specific select signals to a multiplexor **34** which in turn couples

particular switch locations in switch array **51** to microprocessor **32**. Multiplexor **34** is connected to contacts for each of the switch locations in a switch array **51** allowing both the identification code for a switch to be read as well as the switch's state (e.g. off, low, high). Microprocessor **32** determines the combination code associated with each switch present by selecting switch locations through the multiplexor **34** and transmits the combination code along with the switch state to body controller **30** which determines which control signal code to transmit on data link **18** or data link **42**, or whether to activate (or deactivate) a discrete output **53**. Body controller **30** is programmed to identify particular combination codes with particular devices or with the need to issue further instructions to yet another controller. One multiplexor **34** may be provided for each switch array **34**.

[0022] Microprocessor **32** is connected to a multiplexor **34** with six select lines **63**, eight identification lines **61** and three switch state lines **67**. Multiplexor **34** is connected to each switch location **51A-51F** in switch array **51** by eight identification lines **65** and three switch state lines **69**. Should microprocessor **32**. have a large enough number of input pins, multiplexor **34** can be dispensed with.

[0023] Referring to **Figs. 4** and **5**, a switch array assembly **61** implementing the invention is shown. Switch array assembly **61** comprises a housing **161** having a front face **149** in which are defined six switch assembly receptacles or receiving locations **151A-F**. Three switch locations **151A**, **151C** and **151E** are unused and the locations filled by closeout blanks **153**. Three switch locations **151B**, **151D** and **151F** are filled by rocker switch assemblies **151B**, **151D** and **151F**, respectively. Extending from the back of housing **161** are two connecting wire assemblies **145** and **147**. Appropriate resilient locking tabs as known in the art retain switch assemblies in the receptacles.

[0024] Switch array assembly **61** is constructed from a base housing **161** which is characterized by six switch assembly receptacles **151A-F** which pass from the front of the housing through to the back of the housing. The back of the housing is closed by a circuit board **513** which has one face oriented toward the switch assembly receptacles **151A-F** closing the ends of the receptacles distal to front face **149**. As described below, circuit board **513** has contact points on the face oriented toward the housing and cooperating with switch assemblies for identifying the switch and determining its state. Electrical leads **145**

and **147** depend from the ends of the circuit board **513**. Closeout blanks **153** are conventional, being shaped and sized to fit the receptacles and to lock into position with coming into contact with circuit board **513**.

[0025] A back cover **511** fits over circuit board **513** to close the back of housing **161**. Five twist lock lamps **514** may be fitted into and secured in circuit board **513** to provide illumination for the switches. Three rocker switch assemblies are illustrated, which are identical to one another except for modifications to the lead insertion end of the housings from each of which extend a plurality of identification fingers **200**. The number and pattern of identification fingers **200** indicates the function a rocker switch assembly is intended to implement. Otherwise each rocker switch assembly includes a rocker **531**, a biasing spring **529**, a push rod **527**, and an actuation cam **525**, all of which are fitted into each of the housings. As shown by a representative housing **528** in **Fig. 7**, up to eight identification fingers extend downwardly from the housing in two parallel rows of four fingers each, their position unaffected by the state of the switch of switch assembly **529**. For each functional application of a rocker switch a different combination of identification fingers **200** is removed or omitted providing a unique identifier for the function. This is illustrated in **Fig. 8** for one row of fingers **200**, where two of four fingers have been removed leaving two fingers in contact with identification area **202** on circuit board **513**. The function associated with the identification number is programmed into body controller **30**. Identification fingers **200** work by impinging against identification contact areas on circuit board **513**. It will no occur to those skilled in the art that alternative identifying indicia can be used instead of identification fingers.

[0026] Referring now to **Fig. 6**, circuit board **513** is shown illustrating the positioning of contact areas **202** associated with each switch location. Eight identification contact areas **202** are provided at each switch location allowing any rocker switch assembly to be located any location and still be identified. Centered in each set of eight identification contact areas **202** are sets of double switches **204** allowing determination as to which of three states a rocker switch is in.

[0027] The invention provides a configurable switch array in switch types can be identified without depression or closure of the switch. This allows one type of assembly for either two or three position

switches and diagnostic routines to be run identifying which types of switches are present and provide readout of such to a diagnostic computer attached to the diagnostic port.

[0028] While the invention is shown in only one of its forms, it is not thus limited but is susceptible to various changes and modifications without departing from the spirit and scope of the invention.